

SOLAR BURIAL ORIENTATION AND PALEODEMOGRAPHY IN
THE CENTRAL CALIFORNIA WINDMILLER TRADITION

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ABSTRACT. The orientations of burials from four Windmillier Tradition (Early Horizon) sites were examined and found to show significant correlation with the north-south range of the setting sun--a correlation which provides information about seasonal death rates and lends tentative weight to previous suggestions concerning the importance of hunting in the Windmillier subsistence base. Other evidence relevant to Windmillier subsistence patterns is briefly reviewed, and the importance of seasonal mortality data in prehistoric reconstruction is emphasized.

The Windmillier Tradition is a prehistoric complex known from several sites in the Delta region of the Sacramento-San Joaquin Valley. Windmillier components are distinguished culturally by the frequency of large leaf-shaped or stemmed projectile points (presumably used with the atlatl), relative scarcity of seed-grinding tools, typical charmstone and shell ornament types, and by extended (usually prone) rather than flexed burials. This constellation of attributes appears to be limited to the Delta proper (Fig. 1), although Johnson (1967: 187-282, 285-286) excavated a peripheral site (5-237) with a roughly contemporaneous component sharing at least some aspects of the complex. Radiocarbon dates from one Windmillier site, SJo-68, appear to indicate a time span for that site at least, from about 2500 to 1000 B.C. (Ragir 1968: 105-107).

This complex was formerly termed the Early Horizon. Since the "Horizon" system has undergone considerable criticism, colloquia sponsored by the Center for Archaeological Research at Davis in 1968, resulted in the adoption of the term "Windmillier Tradition" to replace it (Gaumer 1968). While this concept will undoubtedly undergo considerable redefinition in the future, as used here it is only a modification of the "facies" concept (Beardsley 1948: 3) expanded to include the related component at site 5-237.

It has been known for some years that the preponderant orientation of Windmillier burials lies in a westerly direction in distinction to the usually random orientation of burials from subsequent periods. Although

this pattern has been noted for all Windmiller sites (Lillard, Heizer, and Fenenga 1939; Heizer 1949; Olsen and Wilson 1964; Johnson 1967: 214; Ragir 1968), no attempt appears to have been made to interpret it.

The most obvious focus for westerly orientation would be the sunset, although in view of the frequent ethnographic references to the souls of the dead crossing the ocean, a sea-orientation might be suspected as an alternate possibility. The purpose of this paper is to test the known range of orientations against these possibilities and to attempt to draw cultural inferences from the results.

THE SUN AND THE SITES

Each day, from December to June, the sun sets at a spot slightly to the north of its position the previous day, and from June to December this trend is reversed. Thus the setting sun as it moves from the point of the winter solstice (late December) in the south, to the point of the summer solstice (late June) in the north, and then back, during the course of the year forms an arc along the western horizon. The size of this arc and the location of the solstice points vary with the latitude, but they are remarkably constant over time. The position of the solstice points does shift gradually due to the change in the earth's equator to the ecliptic, but this amounts to only about one sun diameter, or half a degree, in the last 4000 years (Anderson and Fletcher 1968: 316).

To obtain the present solar range as seen from Windmiller sites solstice and equinox readings were taken by the author with a surveyor's transit just west of SJo-68 (which was under cultivation). While the solar readings consequently are precise for only one of the sites considered here, the close proximity of the sites to each other in relation to the astronomical factors under consideration means that the intersite error factor will be negligible.

Winter and summer solstice points were found to be at 223° and 282° magnetic (or 240 1/2° and 299 1/2° clockwise from true north) respectively. The equinox point is at 252 1/2° magnetic (or 270° true) corresponding to true west. In view of the fact that the original readings were in magnetic degrees, as are those of two of the sites tested, magnetic degrees will be used consistently in this report. Declination at all sites studied is 17 1/2°.

In order to test the possibility of solar orientation Windmiller burial information was examined. Only four of the seven excavated sites provided sufficiently accurate data for testing.

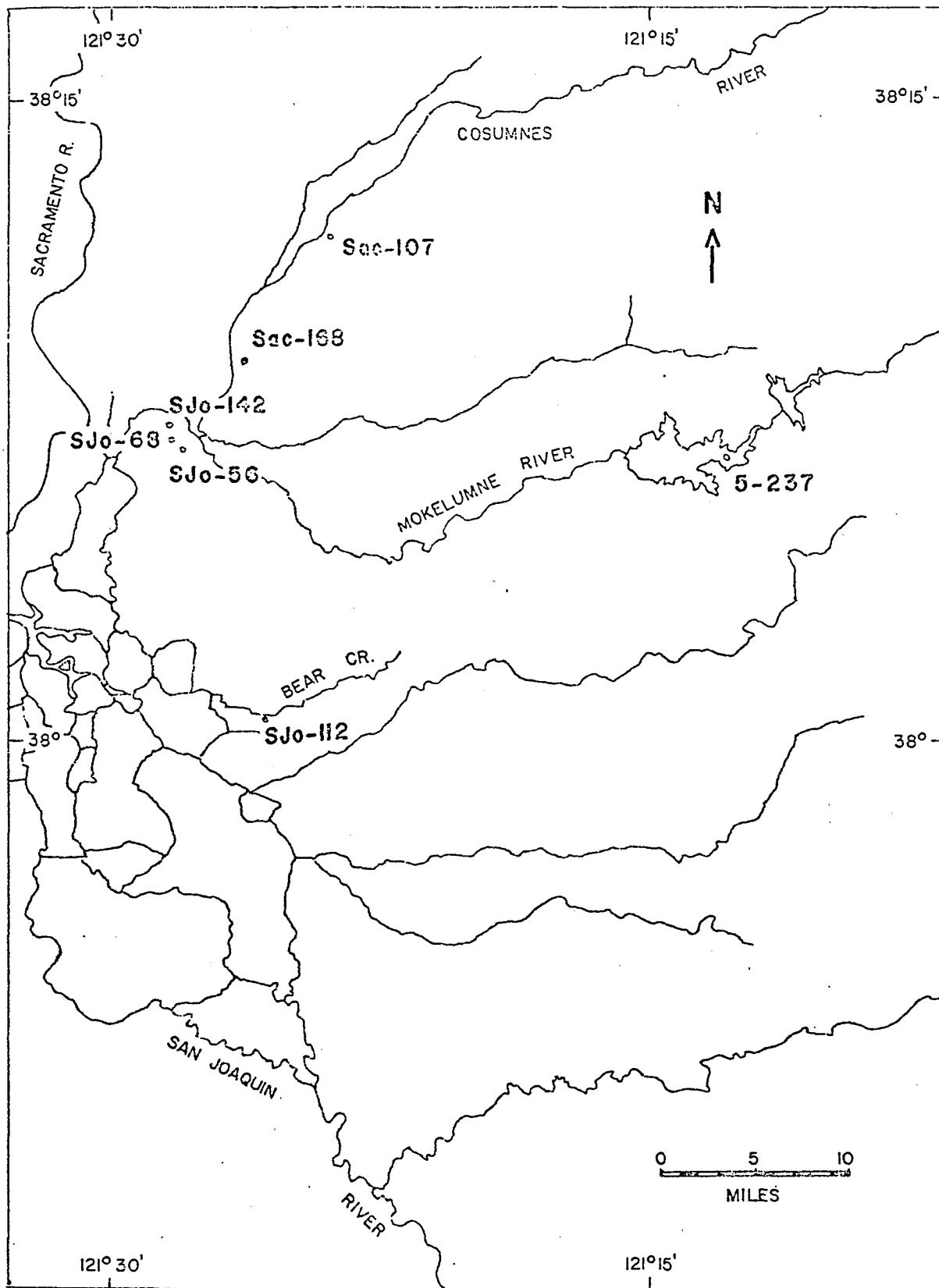


Fig. 1 Distribution of Windmiller Sites in the California Delta.

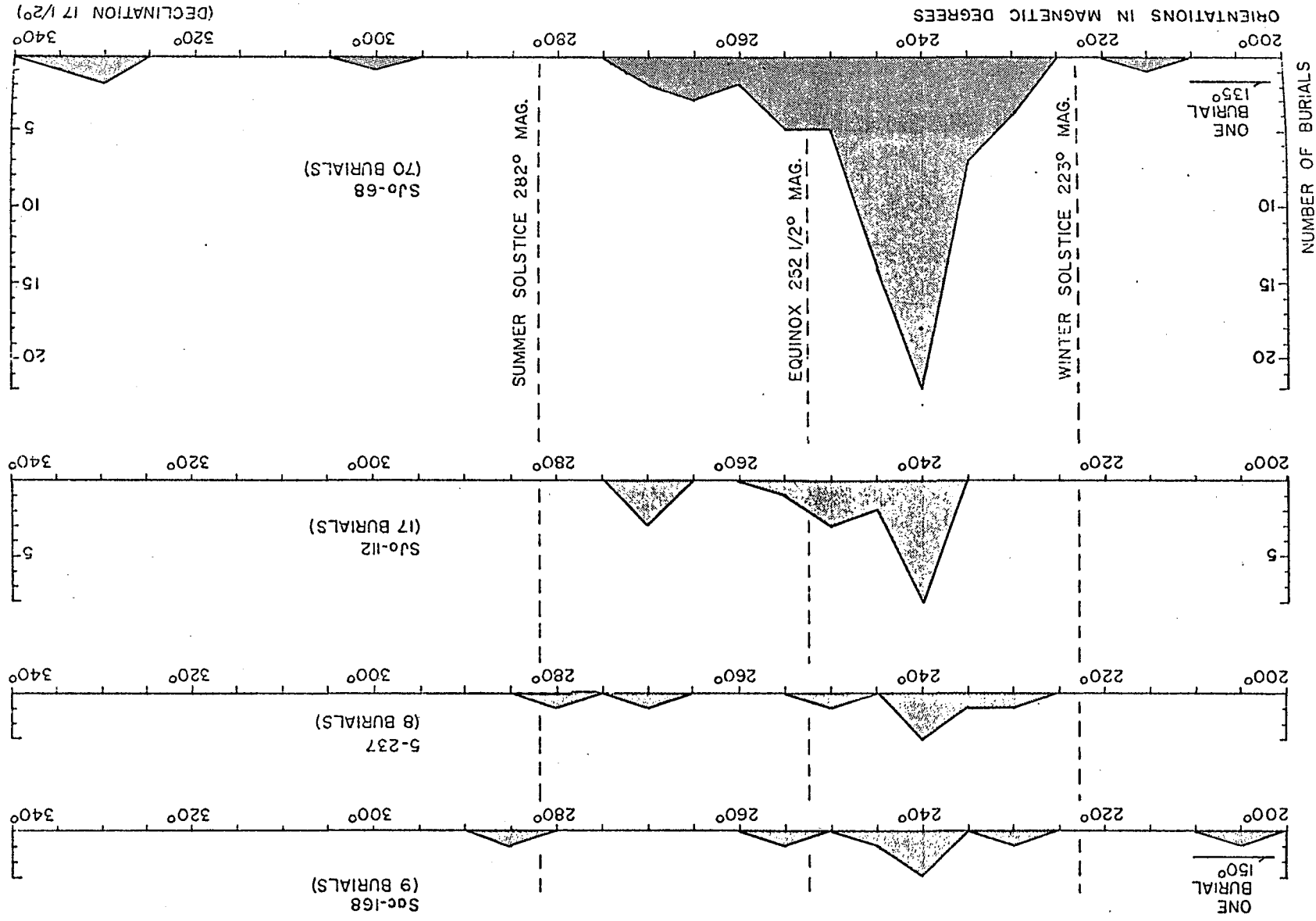


Fig. 2. Extended Burial Orientations at Four Windmill Sites.

The burials from the Old Bridge site (5-237) were segregated by Johnson (1967: 203-204) "on the basis of the relative degree of calcification, burial complement, position, orientation, and matrix" into four components. The Early component is represented by ten burials, eight of which could be used.

A total of 49 burials were excavated at the Bear Creek site (SJo-112) (Olsen and Wilson 1964), although many more had been removed or destroyed by heavy equipment before excavation began (W. H. Olsen, personal communication). Compass readings are reported for seventeen burials, all extended. The site formed a single late Windmill component.

Both the Sac-168 and SJo-68 burials have been analysed by Ragir (1968). The Erich mound (Sac-168) is stratigraphically separated into a Windmill and a Late component. Ragir's burial plans (Maps 5a and 5b) for Sac-168B (the Windmill component) show 27 burials. The orientations of nine of these were clear enough for inclusion.

A total of 154 Windmill burials (including five cremations) are known from SJo-68 (Ragir 1968: 123). Some of these have no recorded provenience, and a few are flexed. Of the extended burials illustrated by Ragir (Maps 8a-8d), 70 show orientations sufficiently clear for testing.

While stressing the faithfulness of these burial diagrams to the SJo-68 and Sac-168 excavation records, R. F. Heizer (personal communication) has expressed strong doubt as to the specific accuracy of the orientations taken in the field and their usefulness for the present study. However, since the concern here is with the distribution of orientations within the range as a whole, rather than with the orientations of specific burials, there seems to be no reason to believe that individual errors would not cancel out, nor that they could be of so significant a degree as to substantially impair the results of the test. To further guard against this source of error, orientations were rounded off to the nearest five degrees.

RESULTS

As will be seen on the graph (Fig. 2), orientations at all the sites correspond closely to the 59° range represented by the solar arc: of a total of 107 testable extended burials from the four sites, 98 lie within the solar range. Application of the chi-square test of association to the figures indicates that randomness is excluded from this correspondence beyond the .001 level at three sites. At Sac-168 randomness is excluded beyond the .01 level. The possibility of orientation directly toward the ocean, or toward any fixed point, may probably be discounted since the distribution curves are not symmetrical--that is, the modal point and the median do not coincide. Fixed-point orientation, further-

more, should be definitely excluded by the fact that distribution curves at all sites peak at 240°. Orientation at this angle from the four sites produces four parallel lines as much as twenty miles apart--a situation which surely does not permit a geographical focus.

It is likely then that Windmiller burial orientation was toward the setting sun (or, what amounts to the same thing, toward the ocean via the setting sun). Given this it now becomes theoretically possible to discover from the angle at which each burial lies, the time of year in which the individual died and, consequently, seasonal mortality rates for the sites. It is not possible, of course, to distinguish spring from autumn deaths by this method, and considering the crude state of the orientation data, it is not advisable to attempt seasonal determination for individual burials. However, if the distribution curves in Figure 2 are divided in half at the equinox point, the result is a division into summer versus winter mortalities.

The resultant figures are rather startling. Of the burials with solar orientation, roughly 80 per cent have died in the winter half of the year. Furthermore, the distributional peak at all sites is at 240°. Seasonally, this corresponds either to the late autumn (October-November) or to the middle of February.

APPLICATION

Throughout California, ethnographic reports indicate that the late winter-early spring season was the most difficult for aboriginal groups--not only in terms of weather, but most especially in scarcity of food resources (Baumhoff 1963: 161). The climate was milder in the Delta than in many areas of the state, and in proto-historic times at least, it supported a higher population than other areas (Baumhoff 1963), but while the meager information on Delta peoples does not illuminate this problem, the situation there can hardly have been qualitatively different than elsewhere. With the rise of the river levels in the rainy season and from spring runoff and with the absence of fresh vegetable resources, almost the whole focus of subsistence activity must have been on hunting. In the Middle and Late periods stored cereals--particularly acorns--appear to have made the dearth of fresh vegetable food of little importance. But if present interpretations of Windmiller economy are accurate, the situation then was quite different, and in lean years, periods of near starvation may not have been uncommon.

The possibility that most Windmiller sites were primarily burial rather than living areas, induces interpretive caution, but the faunal and artifactual remains are nonetheless suggestive.

Heizer (1949: 30) first reviewed the cultural evidence against acorn subsistence in the Windmill Tradition sites:

The remains of seed-grinding implements are extremely rare, and it may be suggested that seeds, such as the acorn, were not very important as a food item. The hypothesis of a Central California group which did not place greater dependence on acorns than any single food resource will seem revolutionary, but this is nevertheless suggested by our present evidence. Further evidence that the historic acorn complex was lacking, or at best undeveloped are the scarcity of cooking-stones (for stone boiling), the near absence of bone awls, which would indicate a slight development of basketry (in which acorn meal is cooked), and the near absence of large fire pits where stones are heated...Mortars and metates are found so seldom that one also familiar with the sites of the later horizons, where these implements are abundant, reaches the logical conclusion that the Early people were not much interested in seeds.

Stone points, by contrast, occur with relative frequency, and faunal remains, while not as abundant as would be expected in a culture where hunting was the main base of subsistence, "are present in sufficient numbers to indicate that a large number of animals were successfully hunted" (Heizer 1949: 30).

Ragir (1968: 189-190), however, partially on the basis of evidence not available to Heizer, suggests a considerably greater role for seed and acorn useage:

Compared to other objects, mortar fragments are fairly common in the deposit of SJo-68, and seed and acorn grinding may have played a substantial part in Windmill Tradition subsistence... Manos, pestles and pestle fragments are rare.

The scarcity of cooking stones mentioned by Heizer is more than made up for by the enormous concentration of baked clay fragments, which may have been substitutes for stone.

But Ragir too (1968: 191) suggests that "hunting was probably the major technique for securing food."

Further evidence in this direction may be provided by paleopathology. Since it is known that vigorous use of the teeth in mastication (such as occurs among predominantly meat-eating peoples) has an inhibiting effect

on caries development (Leigh 1925; Klatsky 1942; Klatsky and Klatell 1943), it might be expected that if Windmillers subsistence relied heavily on hunting, caries rates would be lower than among later people who relied predominantly on acorns (which have a high carbohydrate content--Baumhoff 1963: 162) and fish. There is a preliminary suggestion that this was in fact the case in Kennedy's (1960) finding of a 14 per cent higher frequency of caries experience in the Late Horizon than in the Early (Late: 44 per cent; Early: 30 per cent). Newman's (1957: 54) figures for these horizons are even more divergent, and Brabender (1965: 223) found a still lower frequency (21-25 per cent) among the Windmillers population at SJo-68. This problem has been considered elsewhere (Schulz 1970) and will be discussed more fully in a future paper. It will be sufficient to note that it is unnecessary to postulate hunting as the major subsistence factor: merely that it was significantly more important than in later cultures, while the acorn complex was less developed.

The socio-biological consequences of such an adaptation, as noted above, may have been severe. Indeed, McHenry (1963) after studying radiographs of femora from Early, Middle, and Late burials from several sites in the Delta, indicated that the higher frequency of Harris's lines in Early specimens suggested a recurrent seasonal period of starvation for Windmillers children.

Consequently, it may be hypothesized that the higher frequency of winter deaths is largely attributable to insufficient food resources, the most likely terminal factor being not starvation per se, but lowered disease-resistance consequent upon inadequate nutritional intake.

None of these interpretations, however, are conclusive. Nor, of course, can the seasonal mortality rates reflected on the burial graphs from the four sites be taken as an unbiased sample. Although burial distributions in themselves seem to indicate that the sites were in use--if only for funerary purposes--through much, if not all, of the year, population could have varied greatly with the seasonal round. If the ethnographically known pattern of summer-autumn dispersion to fishing and gathering stations was followed, most individuals dying during these periods might well be interred elsewhere.

While this limits the usefulness of the technique employed here, this preliminary attempt should serve to emphasize various cultural and demographic problems which, hopefully, future work will clarify.

DISCUSSION

The attempt to derive seasonal data from solar orientation is not new: it was proposed, for instance, half a century ago in relation

to the orientation of Bantu kraals (Smith and Dale 1968: 109), and has been attempted inconclusively in connection with burials at the Medea Creek site in Los Angeles County (King 1969).

Other methods of fixing the season of prehistoric burials have utilized biological information. Hill and Hevly (1968), for example, reported the occurrence of large amounts of pollen with an infant burial at Broken K Pueblo. Since this apparently represents an intentional deposition of pollen, or pollen-bearing plants, with the infant, the pollination periods of the plant species involved provide a seasonal date for the inhumation (Hevly, personal communication). And Gilbert and Bass (1967) have been able to assign the deaths of several South Dakota burials to the period between March and mid-October by the presence of fly pupae with the bones.

These or similar techniques might provide a useful check if solar orientation could be tested against them. The importance of such attempts in future excavations should not be underestimated. A further caveat should be noted, however. This paper has dealt only with solar and geographical phenomena. In order to firmly establish the reliability of these or future correlations, all possible foci should be tested. Hawkins (1968) has provided a series of criteria for use in testing architectural alignments, and these should prove useful if adapted to burial orientation patterning. Under optimum conditions these techniques, if applied in future excavations in conjunction with other specialized procedures, could help shed considerable light on such matters as demography, subsistence, settlement patterns, and even religious institutions in Windmill culture.

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